

CHAPTER V

PRICE-FORECASTING EQUATION ESTIMATION'

As discussed in Chapter I, price fluctuations observed in most agricultural crops depend on a wide range of economic and physical factors, such as **climatological** conditions, which may affect per-unit and aggregate yield of a crop in a particular year and thus translate into subsequent changes in crop price. For **most** agricultural crops supply is inelastic in the short run. In other words, changes in crop price cannot affect the quantity supplied in the short run, since supply cannot respond immediately to such changes in price. Furthermore, some agricultural crops (e.g., vegetables) are highly perishable; thus, the quantity produced must be sold immediately after harvest. **These** characteristics of agricultural production imply that quantity produced, perhaps more than other factors, determines the overall level and variation in **prices.**^{2/}

Due to these characteristics, price cannot reasonably be assumed to be predetermined for many crops; consequently, a price endogenous structure of demand is needed to correctly capture the structure of the market. There are, however, some exceptions; e.g., prices of some vegetable or field crops are predetermined, as in the case of "contractual" crops or crops affected by institutional arrangements such as payments, subsidies and quotas on production. Processing tomatoes and market (dehydrated) onions are examples in the first case (contracts) and **sugarbeets** the second case (government support and quota program).

The mathematical model developed in Chapter III features linear demand functions incorporated into a quadratic objective function, with **the** intent of determining prices endogenously. The objective of such a model is to capture the price effect of air pollution. The purpose of this chapter is to discuss the estimation procedure and present the statistical results associated with the derivation of price forecasting equations for the 12 vegetable and 2 field crops included in the study, on a seasonal basis. As pointed out by Adams (1975) and as discussed earlier, **seasonality** of production for vegetables is particularly important. Given the regional production patterns observed in California, correct analysis of comparative advantage, on a regional basis, requires a suitable set of seasonal demand function estimates.

The following subsection describes the procedure for estimating general price forecasting equations. **The** actual results of price forecasting equations for the 12 vegetable and 2 field crops are then presented. A brief summary of the overall estimation will then be given in the concluding subsection.

5.1 Price Forecasting Equation Estimation Procedure

The concept of a price forecasting equation was discussed in Chapter III with respect to a general formulation. In this section, the actual procedure used in estimating such equations **will** be described briefly. The linear demand functions **included** in the model have the following form:

$$p = c + dQ \quad (5.1)$$

where p is a vector ($j \times 1$) of commodity prices, c is a vector ($j \times 1$) of constants, d is a negative diagonal matrix ($j \times j$) of price-quantity slope coefficients and Q is a vector ($j \times 1$) of agricultural crop production. The above equational form assumes that price of a particular crop is affected only by its quantity supplied, i.e., a diagonal " d " matrix implies zero cross-effects for competing commodities.

Consider the following functional specification of a price endogenous demand equation:

$$P_j^c = f(Q_j^c, Q_j^r, s_j, Y) \quad (5.2)$$

where P_j^c = annual seasonal average price received by farmers in California for commodity j .

Q_j^c = seasonal production of commodity j in California.

Q_j^r = seasonal production of commodity j , the rest of the United States.

s_j = existing stocks for commodity j for the United States.

Y = U.S. personal aggregate disposable income.

A priori one would expect that quantity produced and existing stocks would have a negative sign whereas income would be positively correlated with changes in price. That is, an increase in quantity produced of crop j has a negative effect on its own price regardless of where it is sold, **assuming** the crop is homogeneous. An increase in stock tends to indicate a reduction in price since stocks tend to be positively correlated with production and producers tend to increase the level of stocks (for sale in a later period when price is higher) during periods of lower price. An increase in income enables one to consume more (if a good is assumed to be normal) and thus affects **the** price. To keep the assessment problem tractable, it is assumed that the price of commodity j is not affected **by** price or quantity of other commodities, i.e., cross-price effects are zero.

The above formulation **was** used for all seasonal demand relationships for all crops included in the study, except processing tomatoes, cotton and sugarbeets which cannot be estimated by the same procedure due to suspected simultaneity. As a result, a single equation estimation would not be valid; thus, some secondary estimates were used. Ordinary least squares **was** used in estimating the coefficients for all the variables in the above equation, for all the study crops on a seasonal basis. **Once** coefficients **are** obtained for the variables in the price equation, coefficients of all independent variables (except quantity produced in California) are then used to calculate

an "adjusted intercept." This, then, results in a price forecasting equation featuring an adjusted intercept and the **slope** coefficient with respect to California quantity. Results of the estimations, including price-flexibility coefficients, are given in the next section.

5.2 Price Forecasting Equations for Vegetable and Field Crops^{3/}

Vegetables

The **seasonal** patterns and magnitudes of production for the 12 vegetable crops included in this study are described in Adams (1975) and King, et. al. (1978). The period covered in estimating the price forecasting **equations** for the 12 vegetable crops in this study is from 1955 to 1976, using data from Adams (1975) for the period 1955 to 1972. There is a problem attendant to **quantifying** seasonal production for these 12 crops in California after 1972 due to changes in seasonal patterns as reported by the U.S. Department of Agriculture, i.e., the twelve reporting seasons used in the earlier period were collapsed into four. As a **result**, this required **disaggregating** some seasonal estimates for the period 1973 to 1976 into the more numerous seasonal classification employed in the earlier time period. Such adjustments were made for the period 1973 to 1976 to ensure consistency with data from 1955 to 1972. The adjustments, by season, are given in Appendix Table A. The net result is the estimation of 28 equations for the 12 vegetable crops. These estimated equations will be presented below in order of importance, as measured by gross income received in 1976.

1. Lettuce. Lettuce contributes the second highest' gross income to California growers (behind tomatoes--fresh and processing), with a total gross value of \$327.7 million in 1976. This value is almost 70% of the total revenue from U.S. lettuce production. The leading counties are Monterey, San Benito, San Luis Obispo and Santa Cruz in the Central Coast, and Santa Barbara in the South Coast for summer lettuce, spring and fall lettuce. Winter lettuce is produced mostly in Imperial and Riverside counties. Imperial County also dominates production of fall lettuce. The nature and marketing patterns of this and other crops are more completely described in Adams (1975).

Following Adams (.1975), the four **seasonal** Price forecasting equations for lettuce were estimated and presented in Table 5.1. Results of the estimation were not totally satisfactory, even though the signs of all variables except that of "other production" in the winter lettuce were **as** expected. The estimated coefficients of all variables in the winter lettuce are statistically insignificant (5%) and test of **autocorrelation** among error terms is inconclusive at 5% levels of significance in all but one equation. Comparing the results obtained with those in Adams ('1975) shows that the coefficients of determination (**R²**) and the **price** flexibility coefficient with respect to California production are higher in all equations of the same seasons. However, as is true in Adams (1975), the estimated California production slope coefficient in this study is higher than that associated with "other production" in the same season except for fall lettuce. This **result** tends to suggest that lettuce sold in California **vis-a-vis** "other" U.S. production is not homogeneous. Evidence from other researchers (Johnston and

Table 5.1

Price-Forecasting Equations for Lettuce and Fresh Tomato, By Season^a

Crop/ Season	Constant ^b	Estimated coefficient with Respect To:			Summary Statistics \bar{R}^2 : D.W.		Average California Production 1972-76 (Actual)	Price Flexibility With Respect to California Production 1972-76
		California Production	"Other" Production	Personal Aggregate disposable Income				
<u>Lettuce</u>		(1000 cwt.)	(1000 cwt.)	(\$ billion)			(1000 cwt.)	
Winter	2.12	-0.59E-3 (0.48)	0.20E-3 (0.63)	2.78E-3 (0.67)	0.54	2.86 ^e	11903	^c
Early Spring	5.67	-1.27E-3 (-2.27)	-0.47E-3 (-1.19)	10.00E-3 (3.22)	0.52	2.55 ^e	6953	-1.50
Summer	6.60	-0.84E-3 (-2.59)	-0.31E-3 (-0.95)	10.11E-3 (5.24)	0.75	2.02 ^d	10580	-1.30
Fall	2.71	-0.50E-3 (-1.54)	-0.82E-3 (-2.99)	11.90E-3 (4.71)	0.79	1.50 ^e	7617	-0.55
<u>Tomato, Fresh</u>								
Early Spring	0.30	-5.49E-3 (-0.82)	0.47E-3 (0.30)	19.89E-3 (4.83)	0.70	2.45 ^e	378	^c
Early Summer	-3.29	-1.07E-3 (-1.01)	2.34E-3 (2.95)	18.76E-3 (6.44)	0.93	1.89 ^d	3887	-0.19
Early Fall	7.10	-1.27E-3 (-1.23)	-	14.09E-3 (7.65)	0.93	2.46 ^e	2529	-0.18

^aData cover period for 1955 to 1976 crop year with quantity produced expressed in units of 1000 hundredweight (cwt.) and price on actual dollars per cwt. Personal aggregate disposable income (in billion dollars) is for the fiscal year. Numbers in parentheses are estimated t-statistics.

^b Dollar per cwt.

^cNot available due to statistically insignificant and/or wrong expected sign for the estimated coefficient.

^d No autocorrelation among error terms at 5% levels of significance.

^eTest of autocorrelation among error terms is inconclusive at 5% levels of significance.

Dean, 1969; Zusman, 1962) indicates that fresh vegetables produced in California have somewhat **higher** quality compared to that produced elsewhere; hence, it **may** not be unreasonable to expect a divergence across such coefficients.

2. Processing tomatoes. Processing tomatoes in California have a gross value of ~~\$284.7~~ **\$284.7** million in 1976. This value is about 75% of the **national** total. The processing tomatoes industry is one of the most rapidly growing **subsectors** in California agriculture over the last two decades. Several factors such as a favorable climate, advances in production technology, harvesting systems and a progressive canning industry attribute to such growth. Major production areas are **Solano**, Sutter and Yolo counties in the Sacramento Valley; and **Fresno** and San Joaquin counties in the San Joaquin Valley. Total state production in 1976 exceeded 230,000 acres, down from almost 300,000 acres in 1975. This reduction in production is partially attributable to drought conditions in 1976.

It is more difficult to estimate a reasonable price forecasting equation for processing tomatoes, given that processing tomatoes are generally grown under contract between growers and processors. Prices are usually determined prior to planting based on several factors, most important being the carryover of tomato products and the existing market situation, characteristics which suggest simultaneity. Moreover, the estimation of a price forecasting equation for such a crop is further complicated by the fact that processing tomatoes are marketed in various forms such as catsup, juice, canned whole tomatoes, paste and puree, and other concentrated products. Each form does not have the same price flexibility coefficient, as is evidence from the secondary information presented in Table 5.2.

Given these problems, it was decided that the values given in Adams (1975), derived via a weighting procedure of **flexibilities** presented in Table 5.2, will be used for the price-forecasting equation for processing tomatoes in this study.

3. Fresh market tomatoes. Gross income for California fresh tomatoes in 1976 exceeded \$137 million, 32.4% of the national total. Early spring fresh tomatoes are produced mostly in Imperial and San Diego counties. Early summer tomatoes come almost exclusively from the Central Coast (Monterey County), San Joaquin Valley (**Fresno**, Merced, San Joaquin, Stanislaus and Tulare Counties) and the South Coast (**San Diego** County). San Diego and Ventura Counties in the South Coast are the main suppliers of early fall fresh tomatoes in California. California fresh tomato production has to compete with other major production regions such as Florida, Texas, New York, Michigan and Mexico.

The estimated price forecasting equations for fresh tomatoes are given in Table 5.1. The sign attached to the coefficient on early spring California production was not consistent with expectations, i.e., it had a **positive** sign. In such a case, the coefficient had to be reestimated by using a weighting procedure, utilizing the price **flexibilities for other seasons** weighted by the volume of production from 1972 to 1976. The estimated coefficients of "other production" have positive signs, perhaps due to the confounding effects of California production. From the table, it is evident

Table 5.2
Estimated Price Flexibility for California
Processing Tomatoes, 1948-1971a

<u>Product</u>	<u>Price Flexibility Coefficient</u>	California total Shipments ¹ of the Processing Tomatoes, 1975 ^b , (Thousand Tons)
Canned whole	-0.33	566
Juice	-0.23	290
Catsup and Chile	-0.33	369
Puree	-0.10	333
Paste and other	-0.28	1,979
Total		3,537
Weighted average	-0.277	

¹Total shipments = beginning stocks plus pack minus ending stocks.

^aSource: King, Jesse and French (1973), and Adams (1975).

^bBrandt, French and Jesse (1978).

that income was the most 'significant explanatory variable. The price flexibility with respect to California Production obtained in this study is of the same magnitude of that obtained by Shuffett (1954) and Adams (1975).

4. Potatoes. Although California's current potato production is only about 9% of the national total, it contributed more than \$110 million total state gross income in 1976. Kern County supplies most of the California winter and spring potatoes, whereas Riverside County is the major producer of summer potatoes. Fall potatoes are produced mostly in the Central Coast and Siskiyou and Modoc Counties in extreme northern California.

Potatoes are marketed in either fresh and/or processed forms; thus, in estimating the price forecasting equations stock is also included as an explanatory variable. Results obtained are presented in Table 5.3.

From Table 5.3 it is evident that most of the estimated equations are somewhat disappointing with respect to statistical robustness although the estimated coefficients attached to the California production have the expected signs. A divergence of sign is noticed on the disposable income variable for winter and early summer potatoes. One would expect that an increase in personal income will tend to reduce potato consumption and thus depress price since potatoes are usually assumed to be an inferior good.

The estimated price flexibility coefficients are somewhat lower than those estimated by Adams (1975). However, the coefficients of determination in all equations are higher than those of Adams'.

5. Celery. California celery production in 1976 constituted about 66% of the total U.S. production. The gross income in that year is \$78.9 million which is about 60% of the U.S. value of celery production. Of the four marketing periods, Ventura County supplies most of the winter and spring celery. Monterey County, on the other hand, produces most of the early summer and late fall celery. Nationally, California celery faces some competition from other states such as Florida (for winter celery) and Michigan and New York (for early summer celery).

Celery is highly perishable and is marketed only in its fresh form. Thus, in estimating the price forecasting equation only three explanatory variables were used. These variables are California production, "other production," and personal aggregate disposable income. The estimated results are presented in Table 5.4.

As is evident from the table, all the estimated coefficients have the right expected signs and most are statistically significant. Income is the most important variable in explaining the variation of price. Only one equation has an inconclusive test of autocorrelation whereas the rest indicate no autocorrelation among error terms. In terms of competition from other states, the magnitude of the estimated coefficient of production from other areas is higher than that of California for spring celery and vice versa for winter celery. This tends to suggest that cet. par. production outside California has an influence on the price of celery sold in California in the spring season but not in the winter market. The magnitude of the

Table 5.3

Price-Forecasting, Equations for Potatoes, By Season^a

Crop/Season	Constant ^b	Estimated Coefficient with Respect to:				Summary Statistics		Price Flexibility with Respect to California Production for 1972-76	
		California Production	"Other" Production	Stock As at Dec. 1	Personal Aggregated Disposable Income	\bar{R}^2	D.W.	Actual Average California Production 1972-76	Respect to California Production for 1972-76
		(1000 cwt.)	(1000 cwt.)	(1000 cwt.)	(\$ billion)				
<u>Potatoes</u>								(1000 cwt.)	
Winter	-0.49	-0.85E-3 (-1.99)	0.31E-3 (1.82)	0.06E-3 (3.08)	-4.62E-3 (-1.61)	0.71	1.49 ^c	1082	-0.18
Late Spring	2.79	-0.30E-3 (-1.89)	0.26E-3 (1.60)	0.02E-3 (0.71)	0.22E-3 (0.07)	0.62	1.72 ^c	12066	-0.69
Early Summer	8.56	-1.29E-3 (-1.68)	-0.34E-3 (-2.65)	0.02E-3 (1.01)	-4.38E-3 (-1.09)	0.65	2.48 ^d	894	-0.23
Late Summer	7.27	-0.15E-3 (-0.35)	-0.15E-3 (-2.26)		0.06E-3 (0.03)	0.66	1.69 ^d	1761	-0.05
Fall	4.14	-0.04E-3 (-0.33)	-0.03E-3 (-1.90)		7.38E-3 (4.09)	0.77	1.30 ^e	6574	-0.05

(continued)

Table 5.3
(continued)

^aData cover period from 1955 to 1976 crop year with quantity produced expressed in units of 1000 hundred-weight (cwt.) and price in actual dollars per cwt. Stock is in units of 1000 pounds. Personal **aggre-**gate disposable income (in billion dollars) is for the fiscal year. Numbers in parentheses are estimated t-statistics.

^bDollars per cwt.

44

11

^cNo **autocorrelation** among error terms at 5% levels of significance.

^dTest of **autocorrelation** among error terms is inconclusive at 5% levels of significance.

Table 5.4

Price-Forecasting Equations for Celery, Cantaloupes and Broccoli, By Season^a

Crop/Season	Constant ^b	Estimated Coefficient with Respect to:				Summary Statistics		Average California Production 1972-76 ^c (Actual)	Price Flexibility With Respect to California Production for 1972-76
		California Production	"Other" Production	Frozen Stock As at Dec. 31	Personal Aggregated Disposable Income	\bar{R}^2	D.W.		
		(1000 cwt.)	(1000 cwt.)	(1000 lbs.)	(\$ billion)			(1000 cwt.)	
<u>Celery:</u>									
Winter	6.19	-1.35E-3 (-2.22)	-0.35E-3 (-0.57)		4.53E-3 (5.24)	0.68	2.61 ^e	2459	-0.48
Spring	10.70	-1.76E-3 (-2.49)	-2.89E-3 (-3.41)		4.18E-3 (5.35)	0.67	1.83 ^d	2421	-0.69
Early Summer	3.29	-0.62E-3 (-0.71)			4.05E-3 (3.81)	0.65	2.11 ^d	1961	-0.20
Late Fall	6.35	-1.62E-3 (-1.88)			6.42E-3 (6.15)	0.69	1.96 ^d	3667	-0.88
<u>Cantaloupes:</u>									
Spring	6.58	-1.63E-3 (-2.49)	-0.77E-3 (-1.61)		7.83E-3 (7.82)	0.89	2.20 ^d	1197	-0.18
Summer	6.53	-0.54E-3 (-2.69)	-0.52E-3 (-1.27)		5.73E-3 (5.78)	0.90	2.56 ^e	5870	-0.40
<u>Broccoli:</u>									
Early Spring	5.32	-0.72E-3 (-0.76)		-0.02E-3 (-1.92)	12.28E-3 (6.80)	0.93	1.20 ^e	2000	-0.11
Fall	4.68	-2.97E-3 (-1.73)	1.76E-3 (0.60)	-0.02E-3 (-1.65)	17.03E-3 (9.13)	0.96	2.14 ^d	1615	-0.34

(continued)

Table 5.4
(continued)

^aData cover period from 1955 to 1976 crop year with quantity produced expressed in units of 1000 hundredweight (**cwt**) and price in actual dollars per cwt. Stock is in units of 1000 lbs. Personal aggregate disposable income (in billion dollars) is for the **fiscal** year. Numbers in parentheses are estimated t-statistics.

^bDollars per cwt.

^cNo **autocorrelation** among error terms at 5% levels of significance.

^dTest of **autocorrelation** among error terms is inconclusive at 5% levels of significance.

price flexibility coefficients obtained in this study are similar to those obtained by Adams (1975).

6. Cantaloupes. California produces about two-thirds of the total cantaloupes produced in the United States. In 1976, gross income from **cantaloupes** in California amounted to about \$70.4 million (65.2% of the U.S.). Prior to 1972, cantaloupes were marketed in two seasons: spring and summer. After 1972, three seasons were recognized with the third season being fall. Imperial County is the leading production area for spring and fall cantaloupes, whereas **Fresno** and Kern Counties supply most of the California **summer** cantaloupes. Of the three seasons in the present system, summer season accounts for more than 75% of annual production. California cantaloupes face strong competition from other areas such as Texas and Mexico, especially for the summer market. Disease and labor problems and a decline in the price of cantaloupes relative to other less labor-intensive commodities caused a sharp reduction in the spring crop over the past decade [Adams, 1975, p. 88].

Since cantaloupes are highly perishable and are marketed only in fresh form, the formulated price forecasting equations for this crop consist only of three explanatory variables. The estimated results are presented in Table 5.4.

The estimated coefficients for the explanatory variables in all equations have the right expected signs and are statistically significant at not less than 10% levels of significance (except the coefficient for "other **production**" in summer cantaloupes). Income is significant and the coefficients of determination are quite high. The price flexibility coefficient is consistent with that obtained by Adams (1975).

7. Broccoli. California produces **about** 97% of total U.S. broccoli production. Gross income from broccoli production in 1976 was \$65.6 million (99% of the U.S.). Broccoli **is** marketed in two forms: fresh and frozen. Fresh market broccoli was previously reported for two market seasons, early spring and fall. After 1972, however, the market had been broadened to four seasons: winter, spring, summer, and fall. Monterey and Santa Barbara Counties are the main production areas for broccoli in California.

The estimated price forecasting equations for broccoli are given in Table 5.4. All but one variable had the expected signs, the exception being the estimated coefficient for "other production," which is also statistically insignificant. Once again, income **is** the most important explanatory variable in explaining the variations in price of broccoli. The price flexibility coefficients obtained in **this** study again are similar to those obtained by Adams (1975).

8. Carrots. The average production of carrots **in** California over the last 5 years represents **shout** 50% of the national **total**. In 1976, California's market share of carrots was 50.3% with a gross income of \$58.3 million (49.6% of the U.S.). Winter carrots are produced mostly **in** Riverside and Kern Counties, whereas Monterey, Kern and Imperial Counties supply most of the early **summer** carrots. Monterey, Kern and Riverside Counties are also important producers of **late fall** carrots.

Since carrots are marketed in both fresh and frozen forms, the frozen pack is included in the price forecasting equation estimations. The estimated results are presented in Table 5.5.

Of the three estimated equations, winter carrots have the **wrong** expected sign on the **stock** variable. The magnitude of the price flexibility coefficient obtained in this study displays a **wider** range of values than those obtained by Adams (1975).

9. Cauliflower. California is a major producer of cauliflower, supplying about 80% of the national total in 1976. The gross income from cauliflower production in that year exceeded \$50 million (76.8% of the U.'S.). Cauliflower is marketed in fresh and frozen forms. Frozen pack accounts for about 36.5% of the total production and 19% of the gross income from California cauliflower production in 1976. Early spring cauliflower is produced mostly in Alameda and Monterey Counties. Kern, Monterey and Santa Barbara Counties are main producers of late fall cauliflower.

The fact that California cauliflower production faces little significant competition in any season from other sources resulted in only three variables being included in the equation; California production, frozen pack and aggregate income. The estimated equations are given in Table 5.5.

The estimated equations obtained do not have the expected signs for all variables. Most significantly, the **estimated** coefficient attached to the California production of late fall cauliflower has the wrong expected sign. The slope coefficient for this variable was reestimated by using the price flexibility coefficient for early spring production, adjusted to fall quantities and prices.

10. Processing onions. California produces the bulk of the supply of processing (dehydrated) onions in the U.S., due to the state's long growing **season**. Processing onions in California are marketed in summer (late). Total production in 1976 was 7.2 million hundredweight, with a gross income of \$27.5 million. Kern, **Fresno**, Riverside and Monterey Counties are the main producers of processing onions.

Processing onions are grown mostly under **contract** to specific processors. **These** institutional arrangements influence the fluctuations in price and thus the causality of price-quantity relationship; hence, a single equation estimation may not be appropriate. In estimating the price forecasting equation for processing onions, four explanatory variables are included in the model. Results obtained, **shown** in Table 5.5, are not entirely satisfactory, given that the estimated coefficients are either statistically insignificant (10%) or do not have the right expected signs. This tends to confirm the hypothesis stated above. Lack of alternative estimates from more detailed econometric analysts mandated the use of this **equation**, as estimated.

11. Fresh market onions. California fresh onion production contributed only about 23.0% in volume and 17.6% in value to the national totals in 1976. The other states that produce late spring (**or** spring) onions are

Table 5.5

Price-Forecasting Equations for Carrots, Cauliflower, Onions and Beans, by Season^a

Crop/Season	Constant ^b	Estimated Coefficient with Respect to:				Summary Statistics		Average alifornia reduction 1972-76 (Actual)	Price Flexibility with Respect to California Production for 1972-76
		California Production	"Other" Production	'Frozen stock As at Dec. 1	Personal Aggregated Disposable Income				
						\bar{R}^2	D.W.		
		1000 cwt.)	(1000 cwt.)	(1000 lbs)	(\$ billion)			(1000 cwt.)	
<u>Carrots:</u>									
Winter	7.71	-1.48E-3 (-2.13)	-0.54E-3 (-1.91)	0.01E-3 (0.77)	2.02E-3 (1.12)	0.56	2.01 ^d	3438	-0.83
Early Summer	3.10	-0.15E-3 (-0.21)		-0.01E-3 (-1.39)	5.54E-3 (2.27)	0.47	2.28 ^e	4072	-0.10
Late Fall	2.63	-0.18E-3 (-0.39)		-0.02E-3 (-2.42)	7.85E-3 (5.00)	0.68	1.59 ^e	3501	-0.10
<u>Cauliflower:</u>									
Early Spring	5.64	-6.40E-3 (-2.43)		-0.03E-3 (-1.19)	18.47E-3 (9.75)	0.93	1.22 ^e	792	-0.30
Late Fall	3.38	-2.40E-3 (1.69)		-0.07E-3 (-4.28)	10.91E-3 (9.31)	0.96	1.21 ^e	1594	c
<u>Onions:</u>									
Late Spring	3.84	-0.60E-3 (-0.29)	-0.14E-3 (-0.21)	-0.33E-3 (-0.29)	6.23E-3 (1.46)	0.36	2.63 ^e	1788	-0.14
Late Summer	-1.04	-0.01E-3 (-0.03)	0.13E-3 (1.40)	0.12E-3 (0.49)	1.77E-3 (1.21)	0.71	1.44 ^e	7555	-0.01
<u>Processing</u>									
Green Lima Beam	69.61	-0.15E-3 (-0.08)	-1.40E-3 (-1.20)	13.61E-3 (0.79)	218.35E-3 (10.42)	0.91	1.52 ^e	42930	-0.02

(continued)

Table 5.5
(continued)

^aData cover period from 1955 to 1976 crop year with quantity produced expressed in units of 1000 hundredweight (cwt.) except for processing green lima beans which is in tons. Prices are in actual dollars per cwt. except for processing green lima beans which are in dollars per ton. Frozen stock is in 1000 lbs. except processing green lima beans which is in tons. Stock for onion is expressed as **stock** in storage, January 1, in 1000 cwt. Personal aggregate **disposable** income (in billion dollars) is for the fiscal year. Numbers in parentheses are estimated " " t-statistics.

^bDollars per cwt. except for processing green lima beans which is in dollars per ton.

^c**Not** applicable due to either insignificant **and/or** wrong expected sign of the estimated coefficient.

^dNo **autocorrelation** among error terms at 5% levels of significance.

^eTest of **autocorrelation** during error terms is inconclusive at 5% levels of significance.

Texas (66.8%) and Arizona (10.2%). **Gross** income from California fresh onion production in 1976 amounted to \$7.8 million. San Joaquin and Imperial Counties are the leading counties for spring onion production, with Kern and Fresno Counties supplying the remainder of the production.

The variables **estimated** in the price forecasting equation for late spring onions, shown in Table 5.5, are not statistically significant at the 10% level of significance except for personal aggregate disposable income, although the estimated coefficients of all variables have the right expected signs. The test of **autocorrelation** among error terms is inconclusive at the 5% level of significance.

12. Processing Green Lima Beans. Processing green lima bean production in California currently is **about** 45% of the national **total**. In 1976, California produced 25,750 tons at a gross income of \$8.3 million (52% of the U.S. value). Processing green lima beans in California includes two varieties, **Fordhooks** and **baby limas**. Leading producing counties for processing green lima beans are Ventura and **Stanislaus**.

In estimating the price forecasting equation for processing green lima beans, four explanatory variables were used. They were production in California, production elsewhere, frozen pack and personal aggregate disposable income. Results of the estimation are given in Table 5.5.

It is somewhat surprising that although California's share of processing green lima beans represents about 45% of the national total, the estimated coefficient for California production is significantly smaller than that of "other production." This might be due to the fact that about 50% of annual production of processing green lima beans in California are used as dry edible beans, implying a somewhat different demand structure. Only the estimated coefficient for personal aggregate disposable income is statistically significant at the 10% level. The test of **autocorrelation** among error term is inconclusive at the 5% level of significance.

Field Crops

As mentioned in the introductory subsection of this chapter, the market structure of some agricultural **crops** may not be adequately represented by a single equation model due to institutional arrangements and other factors. Thus, the estimation of price forecasting equations for these crops is more **unwieldy** than vegetable crops, requiring a multiple equation econometric model. The two field crops included in this study are examples of these types of crops. Cotton prices were usually muted **by** government intervention, whereas sugarbeet prices were affected by a combination of processor capacity scheduling, government quotas, payments and subsidies [Adams, 1975].. Therefore, the specified price forecasting equation estimation for vegetables discussed above was deemed inappropriate for these **two** crops. Consequently, estimates obtained **from** more detailed econometric sources **will** be used in this study.

1. Cotton. Total acreage harvested of cotton in California in 1976 exceeded **1.1** million acres, yielding about 2.3 million **500-lb.** bales. Gross

income for that year exceeded \$835 million, which is about 25.6% of the total U.S. value. San Joaquin (**Fresno**, Kern, King and **Tulare** Counties) and Imperial Valley are **two** major cotton producing areas in California. The average yield per acre for California cotton production currently is about 1,000 pounds of cotton lint. This yield is higher than the U.S. average (almost twice the **U.S. average** in 1976). Over the period 1972-1976, California cotton **production** averaged about 18.6% of U.S. total production. California's share in 1976 increased to 23%, due primarily to the higher yields obtainable under irrigation, the high quality of cotton planted, and the adaptability of mechanical harvesting systems [Adams, 1975, p. 101].

The price forecasting equation chosen for this study is taken from Adams (1975) and is given in Table 5.6.

2. Sugarbeets. The production and marketing mechanism for sugar in the U.S. are discussed in Adams (1975) and elsewhere. Sugarbeet production in California has increased each year since 1967 with the exception of 1973 and 1974. Total production in 1975 was 8.9 million tons. Gross income received (including government payments and subsidies) in 1975 exceeded \$267 million which is **about** 46% of the U.S. value (1976 figures were not available at the time of this study). Annual yield per acre of sugarbeets in California is higher than the U.S. average (about 40% higher, 1972-1976). Sugarbeets are grown in 31 counties in California. The leading producing counties are Imperial, Fresno, Kern and San **Joaquin**, and Monterey.

The estimated slope coefficient for sugarbeets used in this study is also taken from Adams (1975) and is given in Table 5.6.

Summary of Price Forecasting Equations

The estimated price forecasting equations for the 12 vegetable and 2 field crops discussed above are needed to obtain the linear price structure discussed earlier (see equation 5.1}. The slope coefficient for California production was obtained directly from the equations, except where **the** signs were deemed inappropriate. Two procedures for the calculation of the intercept term were employed. The first, identified as "calculated" intercept in Table 5.6, was derived **by** adding a value to the constant term which would ensure that the "actual" price for 1976 would be predicted when 1976 quantities were used in the price forecasting equation. The second procedure resulted in the obtaining of an "adjusted" intercept. The "adjusted" intercept term reported in Table 5.6 is derived by adding to the estimated constant term all explanatory variables (at mean and 1976 **levels**) except California production. Additionally, price flexibility coefficients were estimated with respect to California production as a means of establishing general credibility of the slope coefficients and as a point of comparison with other studies. A summary of the various intercept calculations and the price flexibility coefficients for each crop and season are presented in Table 5.6. For the purposes of calculating "**price** effects" of air pollution, those equations employing the "adjusted" intercept were **used**.

Table 5.6

Summary of Price Forecasting Equations

Crop/Season	Intercept Term ^a			Slope Coefficient With Respect to California Production	Mean Value for Quantity Divided by Mean Value for Price		Price Flexibility Coefficients With Respect to Calif. Production		R ²
	calculated (1976)	Adjusted			Q/P	Mean Value			
		(1976)	(195 S-76) Mean						
Vegetable Crops									
Processing Green Lima Beans	326.97	333.29	215.20	-0.1543	207.32	139.66	-0.03	-0.02	0.91
Broccoli:									
Early Spring	16.57	15.85	9.30	-0.7267	138.56	151.51	-0.10	-0.11	0.93
Fall	22.64	20.85	11.39	-2.9696	100.51	115.69	-0.30	-0.34	0.96
Cantaloupes:									
Spring	14.40	14.62	9.16	-1.6286	160.88	110.22	-0.26	-0.18	0.89
Summer	12.62	12.40	8.46	-0.5355	1048.61	708.08	-0.56	-0.40	0.90
Carrots:									
Winter	9.05	9.22	7.20	-1.4781	418.40	561.76	-0.62	-0.83	0.56
Early Summer	6.25	7.94	5.11	-0.1667	563.38	686.37	-0.08	-0.10	0.47
Late Fall	9.48	8.32	4.80	-0.1808	596.55	534.50	-0.11	-0.10	0.68
Cauliflower:									
Early Spring	25.91	25.51	14.56	-6.3986	69.89	47.17	-0.45	-0.30	0.93
Late Fall	12.04	11.57	5.72	-2.4036 ^c	124.81	134.46	d	d	0.96
celery:									
Winter	10.53	10.83	7.86	-1.3500	476.57	388.86	-0.66	-0.48	0.68
Spring	10.85	11.43	8.59	-1.7608	400.40	389.85	-0.71	-0.69	0.68
Early Summer	7.56	8.09	3.61	-0.6228	319.02	322.53	-0.20	-0.20	0.65
Late Fall	14.00	13.97	10.04	-1.6232	708.35	544.07	-1.15	-0.88	0.69
Lettuce:									
Winter	5.98	6.36	4.57	-0.5857 ^c	1877.87	1845.43	d	d	0.53
Early Spring	16.55	16.72	9.75	-1.2690	1003.26	1184.50	-1.27	-1.50	0.52
Summer	19.68	17.75	11.60	-0.8376	1846.05	1555.88	-1.55	-1.30	0.75
Fall	14.01	12.57	8.00	-0.5047	1137.20	1081.96	-0.57	-0.55	0.79
Onions:									
Late Spring	5.71	8.97	5.61	-0.5951	308.02	239.04	-0.18	-0.14	0.36
Late Summer	4.00	4.27	2.55	-0.0053	1958.13	2098.61	-0.01	-0.01	0.71
Potatoes:									
Winter	6.86	6.50	5.06	-0.8493	691.72	210.51	-0.59	-0.18	0.71
Late Spring	8.64	9.95	7.69	-0.2997	4712.18	2315.93	-1.41	-0.69	0.62
Early Summer	5.23	5.32	5.34	-1.2448	700.33	175.50	-0.30	-0.23	0.65
Late Summer	4.13	5.27	3.49	-0.1512	870.37	332.20	-0.13	-0.05	0.66
Fall	4.79	4.00	2.07	-0.0377	2123.06	1386.92	-0.08	-0.05	0.77
Tomato, Fresh:									
Early Spring	20.29	26.04	13.21	-5.4866 ^c	33.62	15.87	d	d	0.70
Early Summer	29.60	29.41	14.72	-1.0698	218.76	181.10	-0.23	-0.19	0.93
Early Fall	26.34	23.81	15.18	-1.2692	293.04	142.88	-0.37	-0.18	0.93
Tomato, Processing:	68.00			-2.4800					
Field Crops:									
Cotton	70.17			-0.0296					
Sugar beets	32.46			-0.2655					

^a Units in the intercept terms are dollars per hundredweights for all vegetables except processing tomatoes and sugar beets, which are dollars per ton. The unit for cotton is cents per pound.

^b Units in the slope of coefficients are million hundredweights for all vegetables except processing tomatoes, sugar beets which are in million tons, beans in thousand tons and cotton in million 500-lb. bales.

^c Due to statistical insignificance and wrong expected signs of the estimated slope coefficient, the incorporated slope coefficient is derived from other season price-flexibilities for the same crop, at relevant price and quantity levels.

^d Not applicable due to reasons given under Footnote c.

Appendix Table A
Seasonal patterns of Production for Selected Vegetable Crops in California

<u>Crop</u>	<u>Period To 1972</u>	<u>Period After 1972</u>	
	<u>Season</u>	<u>Actual Season</u>	<u>Adjustments</u>
Broccoli:	Early Spring Fall	Winter Spring Summer Fall	Winter + Spring Summer + Fall
Cantaloupes:	Spring Summer	Spring Summer Fall	Spring Summer + Fall
Carrots:	Winter Early Summer Late Fall	Winter Spring Summer Fall	Winter (Desert) + Winter (Other) Spring + 1/2 (Summer) 1/2 (Summer) + Fall
Cauliflower:	Early Spring Late Fall	Winter Spring Summer Fall	Winter + Spring Summer + Fall
Celery:	Winter Spring Early Summer Late Fall	Winter Spring Summer Fall	Winter (South Coast) + Spring (Central Coast) Spring (South Coast) Summer (Central Coast) Fall (South Coast) + Fall (Central Coast)
Lettuce:	Winter Early Spring Summer Fall	Winter Spring Summer Fall	Winter + 1/3 (Spring) 2/3 (Spring) Summer Fall
Onions:	Late Spring Late Summer	Spring Summer	Spring Summer
Potatoes:	Winter Late Spring Early Summer Late Summer Fall	Winter Spring Summer Fall	Winter Spring 0.3 (Summer) 0.7 (Summer) Fall
Tomatoes, Fresh:	Early Spring Early Summer Early Fall	Spring Summer Fall	Spring (Desert) Spring (Others) + Summer (Others) Fall

FOOTNOTES : CHAPTER V

^{1/} The material presented in this chapter, including the estimation procedure, is borrowed from Adams (1975) and King, et. al. (1978). The interested reader is referred to these references for a **more** complete discussion.

^{2/} As an example, consider the events of spring lettuce of 1978. During that period, the retail price of head lettuce throughout the country increased sharply over prices in the preceding period. This sharp increase was attributed to the reduction of supply caused by heavy rains in the Central Coast region of California, the major source of lettuce supply during spring. However, within a few months, supply conditions improved, reflected in a gradual drop in the price of lettuce.

^{3/} It should be emphasized that these estimated equations are for California, but the regions included in this study only encompass a part of California. Nevertheless, the included regions together constitute a major share of production of the study crops in the state.